

OFFICE OF THE CHIEF OF NAVAL RESEARCH

# DEPARTMENT OF THE NAVY
# EXPLORATORY DEVELOPMENT (6.2)
# FY1992/3 INVESTMENT STRATEGY


OFFICE OF NAVAL TECHNOLOGY

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APPROVED FOR PUBLIC RELEASE

"And we must realize the heavy price we will pay if we look for false economies in defense R&D. Most modern weapons systems take a minimum of 10 years to move from the drawing board to the battlefield. The nature of national defense demands that we plan now for threats on the distant horizon. The decisions we make today -- the programs we push forward, or push aside -- will dictate the kind of military forces we have at our disposal in the year 2000 -- and beyond."

*President George Bush*
*The Aspen Institute Symposium*
*August 2, 1990*

## I. Introduction: The Role of Technology in National Defense

Technology has long played an important role in protecting the freedom and independence of the United States. Technological superiority assumes even greater importance in this period of uncertainty. The edge we enjoy today is a result of past investments in science and technology and the continued search by universities, Navy laboratories and R&D centers, and industry for innovative approaches to the solutions of national security problems. The Nation must continue to cultivate the reserve of technology that will serve as a source of new systems concepts as future needs arise.

Technology, like the world at large, does not remain static. Many potential adversaries of the United States possess formidable research and development establishments devoted to military applications and infrastructures which are becoming increasingly more proficient in buying, modifying, developing and fielding significant military technology advances. New and projected challenges will require all the tools that technology can provide as the United States enters into the 21st Century. Technology not only ensures future options which help to counter external threats, it also helps to better implement those options in both cost and operationally constrained environments.

The Navy's Exploratory Development (6.2) Program plays a crucial role in maintaining the technology leadership needed by the United States. The Office of Naval Technology (ONT), under the Chief of Naval Research, establishes the Department of the Navy (DON) Exploratory Development Investment Strategy in order to ensure that Naval technology development supports the national strategy of the United States and the naval policy for implementation of this national strategy. ONT implements this top-level investment strategy through the Navy Planning, Programming and Budgeting System (PPBS) process by developing a detailed fiscally constrained investment strategy for each warfare mission area which describes the potential operational impact of the planned technology program on the warfighting capability of the Navy and Marine Corps. These 6.2 Mission Area Strategies are published on a biennial basis, the most recent version being the FY 1991/POM-92 edition, to provide guidance to the execution-program planners and performers; to define and prioritize technology thrusts; and to provide the basis for 6.2 technology programs at Navy laboratories and R&D centers or, where appropriate, contractual technology development programs with U.S. industry or universities.

Specifically, this investment strategy is designed to introduce top-down guidance into the Navy technology development process which reflects the changing world security environment, with an attendant evolution in threats, an evolving acquisition process, much tighter defense budgets, new economic alliances and new technological opportunities. While the 6.2 investment strategy recognizes the influence of military research and development upon the civilian economy and private sector R&D, this document concerns itself only with the military aspects of technology development and its role in meeting national security objectives. The civilian and commercial impact of the strategy is significant but will not be detailed here. Nonetheless it should be noted that ONT also oversees the Navy's technical activities in connection with Industrial Independent Research and Development (IR&D) and manages the Navy's Domestic Technology Transfer Program.

This 6.2 investment strategy recognizes the changing military and supporting acquisition context that is confronting future weapon system development. The projected shift in emphasis, from new and complete systems development to emphasis on periodic system upgrades, will have a major impact on how military capabilities are acquired and improved. As fewer major weapon systems are initiated, the insertion of technology through product improvements to upgrade significantly the performance of weapon systems now in the inventory or in development will assume importance during the 1990's. New techniques of designing and testing major development programs will become a central acquisition theme.

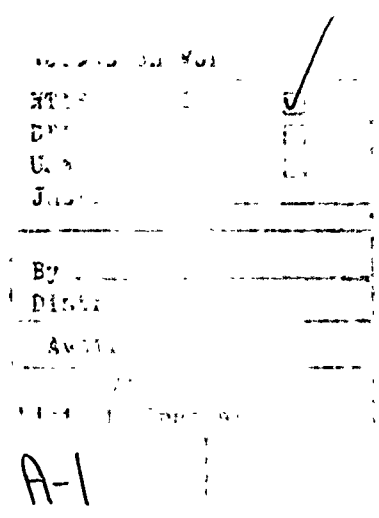
ONT will continue to ensure that the Navy's technology investment is positioned to address the changing National Security environment, including the range of threats posed by potential regional instabilities and low-intensity conflicts. The Navy 6.2 Program for FY 1992/3 fully supports the broad goals and objectives of the Defense Technology Strategy, namely: (1) put in place a process to provide regular, evolutionary improvements in weapon systems, (2) invigorate highly innovative, highly leveraged "breakthrough technology" to maximize the national investment in Defense acquisition, and (3) seek the exploitation of "technology trump cards" to sustain long-term technological dominance.

This Investment Strategy document is structured as follows:

Section II briefly discusses key aspects of the U.S. national security strategy and the associated naval strategy for the 1990's that will affect future 6.2 resource allocations. It also summarizes important naval needs for which innovative technology options serve as a hedge against technological surprise and provide the underpinning for fielding future threat-responsive systems.

Section III presents the corporate goals/objectives for the 6.2 program, the thrusts and priorities of the 6.2 program, and the relative resource allocations among the 14 DON 6.2 Program Elements within the FY 1992/3 President's Budget.

The Appendix briefly discusses the foundational technologies highlighted in the DOD Critical Technologies Plan and presents the relationship of the DON 6.2 Program Elements to those specific technologies.



## II. Investment Strategy Drivers

### A. The National Security Strategy of the United States

The broad national interests and objectives of the United States are enduring and were outlined in the White House's publication dated March 1990 as follows:

1. The survival of the United States as a free and independent nation, with its fundamental values intact and its institutions and people secure.

2. A healthy and growing U.S. economy to ensure opportunity for individual prosperity and a resource base for national endeavors at home and abroad.

3. A stable and secure world, fostering political freedom, human rights, and democratic institutions.

4. Healthy, cooperative and politically vigorous relations with allies and friendly nations.

Given these broad objectives, the military component of the U.S. national security strategy emphasizes four elements: Deterrence, Strong Alliances, Forward Defense, and Force Projection.

Implementing a strategy for the forces, weapons, and technologies that will provide the U.S. with the means to meet the challenges of the changing environment requires consideration of the following factors:

- Deterrence of nuclear attack remains a prime concern of U.S. national security. While improved U.S.-Soviet relations and arms control agreements will lessen the threat, the Soviets will remain the only other Nation with the ability to initiate massive nuclear warfare. A political change in the Soviet Union could occur faster than the U.S. could rebuild neglected strategic forces.

- As the U.S. and its allies adjust their military force structures, each will retain those roles that best match its capabilities. For the United States, these include nuclear forces and space assets, leading edge weaponry, electronic warfare, worldwide presence and a power projection capability.

- As a maritime nation, the U.S. will ensure those forces needed to provide sea control and protect critical sea and air lines of communications.

- U.S. technological superiority remains a cornerstone of defense policy. The U.S. will sustain its investment in science and technology as a hedge against an uncertain future and to avoid technological surprise.

- o Defense investment must address a dual challenge: maintaining sufficient forces to deter general war while simultaneously developing forces suited for the more likely contingencies of regional warfare. Many defense programs contribute significantly in both environments, but potential Third World conflicts also impose special demands.

### B. Future World Environment

A number of world environments may confront the U.S., in particular, during the 1990's:

- o A bi-polar world
- o A multi-polar world
- o A uni-polar world
- o An isolationist world.

Each "world" has different implications for the U.S. Navy and Marine Corps and its strategy. Table 1 summarizes these different environments and the associated military strategy objectives.

## Table 1. NATIONAL SECURITY OBJECTIVES AND MILITARY STRATEGY

| | Bi-Polar World | Multi-Polar World | Uni-Polar World | Isolationist World |
|---|---|---|---|---|
| National Security Strategy | Alliance unity | Maintain power balance | Maintain world stability/ cooperation | Avoid foreign entanglement |
| Strategic Concept | Conflict containment Escalation dominance | Divide hostile alliances | U.S. leadership to build coalitions | Insulate U.S. from external world |
| Military Objective and Strategy | Forward defense | Flexible reaction | Multinational operations | Territorial defense |

In a "bi-polar world," U.S. foreign policy would be directed to maintaining the alliance structure of the western nations. Military strategy would use forward deployments to solidify alliances and to provide rapid responses in cases of military confrontations. The primary concerns in this kind of world would be countering an expansion of Soviet influence vis a vis the U.S. and controlling escalation of a military confrontation between the superpowers. Military force would be used to contain the conflict geographically and control the level of violence.

In a "multi-polar world," alliances would lack permanence and conflict could arise from both economic and ideological differences in addition to traditional East-West divisions. Major powers would compete economically and perhaps develop regional spheres of influence. U.S. military policy would reflect alliance fluidity by developing flexibility and fostering independence. The basic threat in this "world" would occur from a hostile coalition. In the event of conflict, military strategy would be dedicated to splitting the coalition, perhaps by directing military force against its weakest member.

In a "uni-polar world," U.S. national security would be ingrained with the desire to maintain the status quo of the balance of power. This world situation poses a planning dilemma: namely, how to build economic and military alliances that hedge against the breakdown of the uni-polar structure without threatening the existing world balance. Multinational operations rather than unilateral initiatives would become the modus operandi.

The "isolationist world" would represent a fundamental change in U.S. doctrine. While all the other scenarios stress countering external threats at the sources, U.S. military policy in this "world" would focus on insulating the U.S. from external threats, and place a limited geographical dimension to military operations. The existing international world economic interdependence makes this scenario the least likely.

Selection of any one operating environment as the basis for structuring U.S. naval forces would be unwise; however, global and regional warfare are the prime planning factors. A consensus environment would include the following characteristics:

- o More places and more players
  - Cluttered; confused; situational allies
  - Less preplanned allied support
  - More complex political orchestration
- o "High Tech" opponents (nuclear, biological, chemical weapons, and tactical and intercontinental missiles)
- o Variable warning times and conflict intensity levels
- o Fewer overseas bases and restricted overflight rights

- o Sustained presence; short, violent conflict
- o Potential for a lesser open-ocean and U.S. territorial threat
- o A diminished strategic nuclear threat but a proliferation of nuclear weapons.

The Navy's Exploratory Development plans must address this diversity of possible future environments and provide the technology base to respond to the spectrum of conflict.

### C. Naval Policy for the 90's and Beyond: Meeting the Challenges of a Dynamic World

The evolving geopolitical environment has broad policy implications for the United States. With world order in flux, and the forecast of fewer U.S. naval forces, there is a clear need for a naval policy that responds to the changes.

President Bush, in his Aspen Institute address, stated the issue well when he said, "The United States would be ill-served by forces that represent nothing more than a scaled-back or shrunken-down version of the ones we possess at present. If we simply pro-rate our reductions -- cut equally across the board -- we could easily end up with more than we need for contingencies that are no longer likely -- and less than we must have to meet emerging challenges. What we need are not merely reductions -- but restructuring."

While the Maritime Strategy of the Cold War era has been modified it remains "on the shelf" and is ready for use if the need re-emerges. But not all elements have been shelved; three enduring principles form the foundation of the naval policy for the '90s:

- o Forward peacetime naval presence remains essential for deterrence and rapid crisis response.
- o Naval force structure must mirror the policy objectives and mission requirements that naval policy dictates.
- o Naval warfighting doctrine remains an option at any level of conflict, should deterrence fail.

In response to the evolving national security environment, the U.S. Navy has established a policy for the 1990's which emphasizes maintaining a capable, balanced naval force. It includes:

- o Compensating for the impact of reduced naval force levels
- o Emphasizing joint/combined forces operations

- o Maintaining its emphasis on power projection, flexible deployment and rapid surge capability

- o Enhancing its technological capabilities and hedging against uncertainty.

During the Cold War era, national security stressed preparation for global conventional war and strategic nuclear war, and planning was pre-occupied with the Central European Theater scenario. Although there is a reduced likelihood of global warfare for 1991 and beyond, sound judgment compels the U.S. to remain prepared to counter both the Soviets' significant conventional military capability and their nuclear forces. But the reduced probability of such a confrontation allows a shift in the planning focus from global containment and warfighting to world stability with an emphasis on regional warfare. The resulting paradigm shift is driven by a projected increase in the likelihood of regional instabilities and conflicts outside the U.S.-Soviet context. The United States must plan to respond to multiple, unrelated crises and regional conflicts. These changing circumstances will place an increased importance on power projection tied to local sea control. And new concepts of Navy and Marine Corps force packaging and employment will be required to compensate for shrinking force levels.

Regional military powers continue to acquire more sophisticated and lethal weapons and delivery systems, despite efforts to restrict their flow. The variety of weapons sources, coupled with the ready availability and relatively low cost of acquiring technology through commercial markets, will perpetuate this trend. Chemical and biological weapons are increasingly available, stealth technology will proliferate rapidly, and several Third World nations may soon acquire nuclear weapons. Furthermore, these nations may be more willing to employ weapons of mass effect tactically. Therefore the descriptive term "Low-Intensity Conflict" is inappropriate for this type of warfare. This situation will require continued reliance on robust platforms and modern weapons capable of countering threats posed by both high-tech conventional weapons and weapons of mass effect.

The shift in focus from global Soviet containment to regional stability requires that the size and composition of naval forces reflect the changed world and updated national military strategy. Sea-based strategic nuclear forces will continue to provide deterrence against nuclear attack. Conventional forces deployed in peacetime must be sufficiently powerful to dissuade would-be adversaries. A forward naval posture will perpetuate the need for a blue-water force that carries its own logistical support. Increasing restrictions and unavailability of overseas basing will amplify the need for self-contained repair, medical and supply capabilities. These factors impact three elements of naval strategy: Force Projection, Sea Control, and Undersea Warfare.

Focus on Force Projection. The force projection mission will see a decrease in emphasis on conventional power projection against the Soviet homeland, but the demands for U.S. power projection in lower-level conflicts will increase. Even with an emphasis on long-range standoff weapons, the requirement for mission presence will require the ability to project tangible evidence of power. In this role, no other platform provides the flexibility, sustainability, and endurance as that of the aircraft carrier. Thus, the relatively high

probability of regional conflicts and the potential loss of overseas bases assures a continued role for the carrier battle group and the surface fleet. This situation stresses the need for a mobile, flexible force that can operate globally without dependence on forward bases. Effective power projection operations will require Carrier Battle Group and Marine Corps force levels that will permit robust forward presence in peacetime and an early surge capability for follow-on land-based Air and Army forces and extended multiple CVBG/MAGTF operations in crisis and conflict.

Assure Local Sea Control. Sea control is a prerequisite to effect any maritime strategy. Accordingly, protection of Sea Lanes of Communication (SLOC) and the ability to execute strategic sea lift must receive high priority. Local sea control is necessary to insert naval forces without hinderance by enemy actions. Concepts of sea control will evolve with specific scenarios, but the absence of immediate Soviet air, surface, and subsurface threats shrinks the battle space and the open-ocean scenario becomes a problem of local sea control. Although it is characterized as local sea control, the area to be controlled may be sizeable, and possibly larger than what is considered local sea control today.

The potential for open-ocean attack has been reduced because regional adversaries are not as likely to acquire or concentrate sufficient naval forces for open-ocean confrontations. Future threats to U.S. naval forces are more likely to be confrontations in littoral areas. Several coastal nations are acquiring considerable firepower that could challenge U.S. power projection forces, but their capabilities will be limited primarily to operations in the immediate theater. Conventionally powered submarines, smart weapons, and advanced aircraft will create an intense and lethal combat environment and operating in littoral waters changes some requirements:

- The outer air battle threat is reduced in the expected number of attacking aircraft and incoming missiles, but local air superiority is still necessary.

- The near-shore environment reduces maneuvering room and complicates air defense by requiring air superiority over land.

- The capability to perform effective ASW operations in shallow water increases in importance.

- A knowledge of the natural environment in foreign littoral zones is critical to modern warfare and data must be collected prior to the initiation of hostilities.

The reach of opposing weapons systems that can target naval task forces may be somewhat reduced. But the trend toward higher technology weapons will demand both quick-reaction systems for close-in threats that give little warning and a connective system of command, control, communications, and intelligence enhancing joint and allied capabilities. Future threats such as tactical ballistic missiles will also pose a technical problem.

Preserve U.S. Undersea Advantage. Undersea warfare is changing, but the threat will not disappear. Since the Soviets maintain sufficient numbers of extended-range nuclear submarines capable of global interdiction, prudence dictates that the U.S. maintain an open-ocean ASW proficiency against progressively quieter threat submarines -- even though extended SLOC protection and open-ocean ASW will not be as critical in regional conflicts. Third World navies continue to acquire large numbers of modern conventional submarines which present formidable threats. Most of these will be deployed in littoral areas and create difficult problems for the U.S. in performing shallow-water ASW, but these platforms are also capable of extended ranges. U.S. technological advantages accrued over many years must be maintained and improved. Countering the quiet submarine will be key to mission success, but will become increasingly difficult and will require a modernized ASW capability to perform effectively in a wider range of environments. Expanded use of active sonar and the emergence of a role for nonacoustic ASW can be anticipated. Passive acoustic detection will become even more difficult, but significant advances in sensors and signal processing and increased tactical exploitation of the ocean will keep passive acoustics in the picture.

### D. Future Naval Needs

In the future, the number of surface combatants in any particular battle group will depend on the threat environment and on the complexity of the mission. Low numbers are sufficient for performing the presence mission in a "peacetime" environment, but higher numbers of surface units obviously would be required for combat. However, even comparatively low threat scenarios, such as the Maritime Interception Operations, may require many surface combatants and/or submarines. The U.S. is accustomed to deploying forces with aircraft carriers as the capital ship. But as we move away from the bi-polarity of U.S./Soviet confrontation, different deployment concepts will be employed. Likely future scenarios include a diversity of U.S. interests and may require presence and power projection needs greater than that which could be met with the future inventory of carrier battle groups. Employment of small battle groups places an increased demand on the self-protection capability of individual units.

However uncertain the threats and however varied the missions, the United States will remain fundamentally a maritime nation. It must maintain the ability to secure the sea lanes that connect it to its allies, commercial markets and resource suppliers. A distillation of the above dynamics leads to the following needs that will impact the technology base:

- The power projection role is becoming more important.
- Regional warfare places an increased emphasis on shallow-water ASW.
- The requirement for conventional weapons with greater precision, longer range, and greater lethality is a common thread.

- Signature management will be necessary for operation in heavily defended forward areas.
- Countering stealth vehicles changes the dimensions of the battlefield -- expands for scouting and surveillance and shrinks for point defense.
- Availability and survivability of space assets are becoming more crucial for indications and warning.
- $C^3I$ becomes pervasive and interconnectivity is more critical for timely response to changing battlefield conditions.
- Counter-$C^3I$ is increasing in importance.
- Electronic combat will assume increasing priority.
- Sustainability in forward areas becomes crucial.
- Individual unit self defense assumes higher priority.
- Worldwide environmental quality and pollution concerns will increase.
- Continued introduction of high-technology equipment demands higher skill levels.
- Embedded training and simulation are potential offsets to at-sea exercises.

## III. Investments and Rationale

Naval forces must continue to develop resources to maintain the edge against increasingly more capable adversaries. Maintaining the lead in advanced technologies is critical to success in combat. Naval forces must be prepared for instant response to the threat posed by sophisticated first-world weaponry in the possession of third-world adversaries. Protecting the country's edge in defense means continuing to invest in Research and Development.

### A. Corporate Goals/Objectives

The Office of Naval Technology's overall goal is to provide the Navy and Marine Corps with new and improved fleet operational capabilities in the most cost-effective and timely manner possible. This goal is achieved by developing technology to:

- keep ahead of the projected threat
- provide affordable system options
- reduce fleet operating costs
- avoid technological surprise.

Achieving these goals will provide the Navy with a technology reserve in the form of a knowledge and capability base which can be tapped as military needs arise.

However, establishing a coherent DON Exploratory Development (6.2) Investment Strategy is particularly difficult in the present environment where there is little consensus regarding the future. In addition to addressing the external threat environment, technology must support the DON's resource management policy and its acquisition strategy. There are tradeoffs to be made in addressing Navy needs in an era of declining resources:

- capability vs. quantity
- divesture vs. consolidation
- modernization vs. new systems
- active vs. reserve forces.

These on-going changes are formidable and will necessitate changes in the R&D balance.

Recognizing that uncertainty can be expected to persist during this period of adjustment to rapid change, the Exploratory Development Program's overarching goal is to develop and maintain a robust technology base which will provide the Navy and the Marine Corps the flexibility to respond to changes in both the threat and acquisition environments. Thus, the

6.2 program investment strategy targets resources so as to achieve the following three objectives:

- o Ensure the availability of technology needed for identified system development and product improvements (*Systems requirements pull*).
- o Advance the state-of-the-art in technologies that enable warfighting capabilities needed across the full spectrum of potential naval conflicts (*Capabilities pull*).
- o Establish a technology base for revolutionary new military capabilities (*Technology push*).

In the present defense atmosphere, we expect the overall need for investment driven by near-term system requirements pull to decrease, but a more concerted effort will be required to deliver the supporting technology base products in a timely manner for the fewer surviving development programs. The capabilities-pull portion of the 6.2 program will receive increased emphasis. The specific timing regarding implementation of needed capabilities may be uncertain, but the technology community cannot afford to wait for definitization of system needs before beginning exploratory development, if the needed technology is to be mature when ultimately required for acquisition programs. Technology push will remain a key element in the 6.2 portfolio, with emphasis commensurate with technological progress in the basic research community.

Essential to achieving the program objectives is maintaining the strong in-house laboratory, industrial, and university team that carries out the research and development projects funded by ONT. The DON is committed to ensuring balanced participation in the 6.2 program by all three sectors, as shown for FY 1990 in Figure 1.

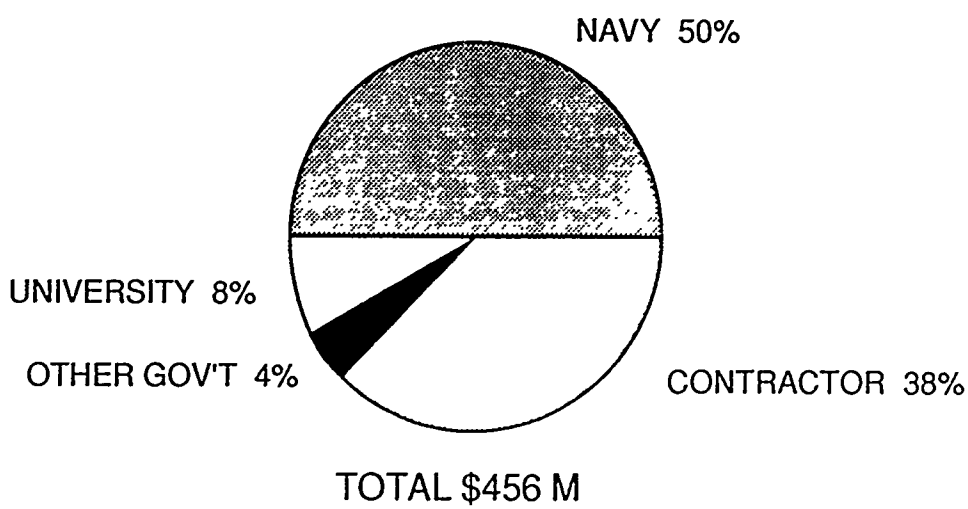



**Figure 1. NAVY 6.2 EXPENDITURES FOR FY 1990.**

## B. Thrusts and Priorities

The corporate investment strategy for the DON 6.2 Program is to balance the portfolio over short-, mid-, and long-term needs and allocate resources to each warfare area on the basis of needs, Navy uniqueness, industrial base investment, and technological opportunities. The specific elements of this investment strategy are provided below (in italics) with exemplary program objectives delineated below the strategy element they support.

- *o Emphasize weapons and surveillance technologies, and their related countermeasures.*

  - Define the physical and technological limits of passive acoustic submarine detection by fixed undersea surveillance arrays.

  - Enhance detection, classification and localization performance of 1st-generation low-frequency active systems; lay the technological foundation for 2nd-generation systems.

  - Advance the state-of-the-art in support of block upgrades, $P^3I$, and next-generation torpedoes.

  - Augment existing acoustic search systems with nonacoustic systems, especially in difficult ocean environments.

  - Develop advanced mine warfare systems for shallow-water application.

  - Integrate point defense weapons, electronic warfare, and sensors to effectively counter low-observable platforms and weapons.

  - Provide capability to suppress enemy defenses with anti-radiation and autonomous long-range stand-off weapons.

  - Develop survivable missiles and platforms employing integrated hard-kill and soft-kill, reduced signature and survivable structures technology.

  - Develop the capability to detect, classify and target aircraft and ships from ship, aircraft and space platforms using both active and passive systems.

  - Develop passive sensors and low-probability-of-intercept radars in support of reduced signature platforms.

  - Produce internetworking technology for timely, secure and enduring $C^3$ systems connectivity.

  - Develop high-energy-density materials and improve warhead lethality.

- *Provide moderate, sustained support for platform technologies that meet unique Navy and/or Marine Corps needs.*

  - Increase speed of amphibious landing vehicles and reduce their vulnerability in over-the-horizon amphibious operations.

  - Improve life-support systems and expand endurance of delivery vehicles.

  - Focus submarine effort on advanced pressure-hull concepts to improve performance, reduce signatures and increase survivability.

  - Develop materials to improve reliability and performance of naval nuclear reactors.

  - Investigate X-31 super-maneuverability technology for naval aircraft applications.

  - Develop technologies to ensure the diagnosing, servicing and repairing of stealth aircraft at sea.

  - Develop automatic deck equipment for reduced manning and higher turn-around on aircraft carriers.

  - Develop electric power distribution system, machinery monitoring and control technologies, and superconducting motors in support of the Navy's Integrated Electric Drive initiative.

  - Improve ship and submarine survivability through a balanced approach to total ship signature management.

- *Provide stable, sustained support for mission support areas, such as personnel/training, logistics, biomedical, tactical oceanography, environmental protection and chemical/ biological (CB) defense.*

  - Develop bio-engineered materials for environmentally safe, long-life hull coatings.

  - Improve chemical agent detection capability and enhance protective equipment for application in the marine environment.

  - Enhance tactical decision-making capability of individuals under stress.

  - Develop improved measurement techniques and modeling capabilities that exploit ocean characteristics to improve ASW system designs and enhance their tactical use.

- *Ensure a vigorous technology base in core technology areas such as electronic devices, advanced materials, human factors, and computer technology.*

  - Develop efficient solid-state laser technology for submarine communications, submarine and mine detection, and infra-red (IR) countermeasures.

  - Develop high-speed, high-resolution Analog-to-Digital (A/D) convertor technology for ASW, shipborne and radar applications.

  - Improve composite materials with high heat-dissipation capability for controlling platform signatures and improving electronic component reliability.

  - Develop artificial diamond technology for erosion-resistant IR missile domes.

  - Develop advanced multidimensional visual/auditory display concepts to enhance detection of underwater targets.

  - Demonstrate how advances in high-performance computers can improve Navy sensor processing, strategic and tactical decision making, and weapons control.

- *Target programs that address affordability issues.*

  - Provide advanced test and evaluation technologies capable of assessing advanced aviation capabilities.

  - Grow Navy computer effort in integrated methodology and tools for designing and updating complex, real-time mission-critical software systems.

  - Provide low-cost alternatives for tactical missile autonomous guidance and control.

  - Develop condition-based maintenance techniques to replace expensive time-directed maintenance techniques.

  - Demonstrate integrated circuit technology to produce very low-cost hydrophones for both deployable and fixed arrays.

  - Reduce cost of torpedo exercises by recharging Stored Chemical Energy Propulsion System (SCEPS) boiler with lithium fuel vice replacement.

- *Increase inter-service reliance by developing joint programs and collocating appropriate efforts in lead-service laboratories while maintaining Navy control over Navy investments.*

  - Maintain strong joint/cooperative programs with other services in areas of

common interest, e.g., advanced high-performance turbine engine technology (IHPTET), solid-state electronic devices, guidance and control for conventional weaponry and electronic warfare.

- Assume OSD-assigned leadership role in microwave tube technology.

- Integrate DARPA investments in submarine technology into Navy plans for next-generation submarines.

- Through joint programs and other-service investments, leverage industry development of aerospace technologies.

o *Encourage a strong international cooperative program to leverage off-shore technology expertise.*

- Continue participation in The Technical Cooperation Program (TTCP) -- with the U.K., Canada, Australia, and New Zealand.

- Utilize appropriate NATO panels to foster cooperative programs.

- Support Secretary of Defense exchange initiatives with Japan in accelerated-cooled, direct-quenched (AC/DQ) steels and magnetic ship silencing.

o *Rebuild/maintain the Independent Exploratory Development(IED) Program Element to provide the flexibility to rapidly exploit new and highly innovative technologies.*

- Expand participation to include the Navy's corporate laboratory.

- Fund those Navy laboratories participating in the IED program at a target level equal to 5% of their in-house DON 6.2 funds.

- Support timely solutions to specific operational problems of Navy and Marine Corps forces through the Navy Science Assistance Program.

- Expand the ONT Post-Doctoral Fellowship Program to foster program innovation and recruit new talent.

o *Support the DOD Critical Technologies Plan.*

- Maintain at least 40% of the DON 6.2 program in investments developing DOD Critical Technologies. (See Appendix)

- Focus investments in DOD Critical Technologies so as to complement investments in Navy core technologies.

- Stress achievement of Naval mission capabilities through a management approach that stresses goal-oriented integration of diverse technologies.

## C. Program Implementation

Implementation of the investment strategy described above is depicted in Figure 2, which displays the relative resource allocations among the 14 DON 6.2 Program Elements within the FY 1992/3 President's Budget. Because the changing world environment carries with it investment implications within each warfare mission area, as outlined in Section II, the programmatic balance across warfare areas that is reflected in this figure is essentially preserved over the Future Years Defense Plan (FYDP). These projections are reviewed on an annual basis and adjusted based on technical progress, priority changes, and available funding.

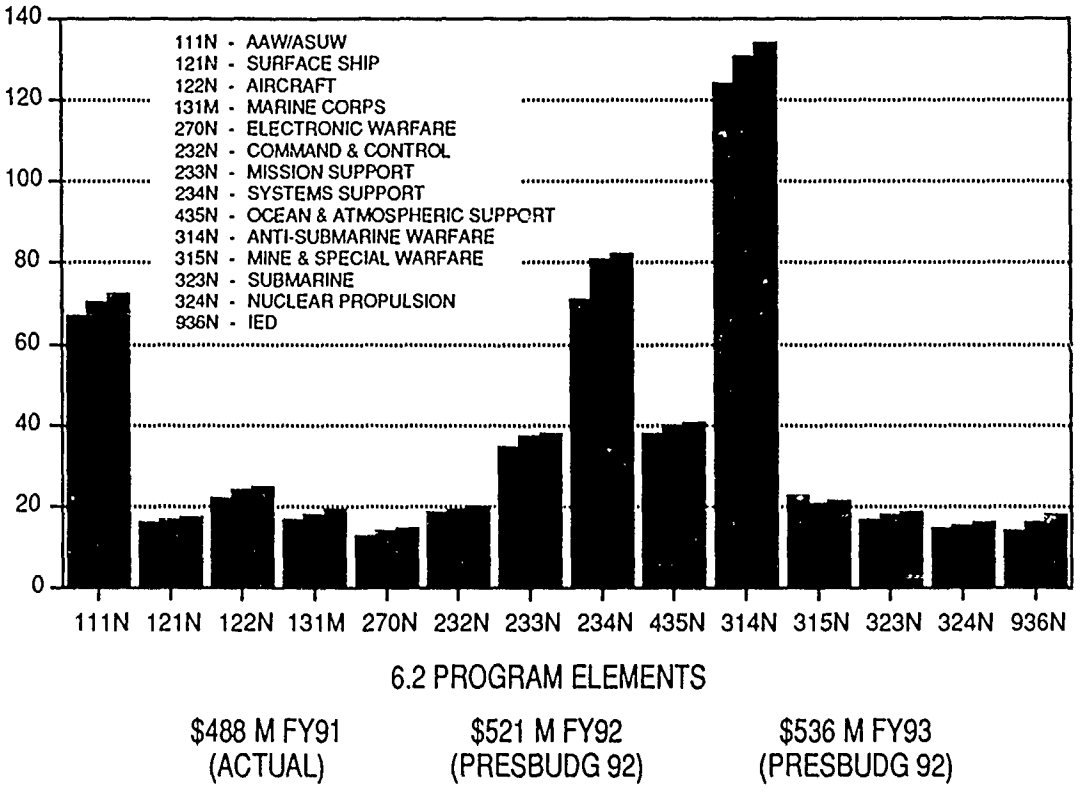



Figure 2. 6.2 PROGRAM ELEMENT FUNDING TREND FY 91-93 ($M).

Specific programmatic actions implemented within the current investment strategy, i.e., within the FY 1992/3 President's Budget, include:

- Institutionalized ASW and tactical oceanography investments at levels corresponding to the FY91 Congressional appropriations in those areas.

- Continued to rebuild the IED Program investment toward the target level discussed on page 16.

- Provided strong resource commitment to programs that address low-intensity conflict requirements, such as Chemical/Biological Defense, Special Warfare, Tactical Decision Making Under Stress, Shallow-water ASW, and Mine Countermeasures.

- Provided special emphasis to selected high-interest areas: Solid-State Lasers; Sea Launch and Recovery (SEALAR); Integrated High-Performance Turbine Engine Technology (IHPTET); X-31 super-maneuverability technology; microwave tube technology.

ONT has positioned the DON Exploratory Development Program to address the Department of the Navy's technology needs within a changing National Security environment, including the range of threats posed by potential regional instabilities and low-intensity conflicts. The FY 1992/3 program fully supports the Defense Technology Strategy to provide evolutionary improvements to existing weapon systems while simultaneously leveraging "breakthrough technologies" and exploring "technology trump cards." ONT will continue to refine the objectives, thrusts, and priorities of its investment strategy and focus the program's financial resources to ensure that the DON Exploratory Development Program remains responsive into the future, as this era of change unfolds.

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- Continued to rebuild the IED Program investment toward the target level discussed on page 16.

- Provided strong resource commitment to programs that address low-intensity conflict requirements, such as Chemical/Biological Defense, Special Warfare, Tactical Decision Making Under Stress, Shallow-water ASW, and Mine Countermeasures.

- Provided special emphasis to selected high-interest areas: Solid-State Lasers; Sea Launch and Recovery (SEALAR); Integrated High-Performance Turbine Engine Technology (IHPTET); X-31 super-maneuverability technology; microwave tube technology.

ONT has positioned the DON Exploratory Development Program to address the Department of the Navy's technology needs within a changing National Security environment, including the range of threats posed by potential regional instabilities and low-intensity conflicts. The FY 1992/3 program fully supports the Defense Technology Strategy to provide evolutionary improvements to existing weapon systems while simultaneously leveraging "breakthrough technologies" and exploring "technology trump cards." ONT will continue to refine the objectives, thrusts, and priorities of its investment strategy and focus the program's financial resources to ensure that the DON Exploratory Development Program remains responsive into the future, as this era of change unfolds.

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## APPENDIX

### DOD Critical Technologies

Public Law 101-189 of November 1989 requires that the Secretary of Defense submit to Congress an annual plan for developing those technologies considered by DOD and DOE to be the most critical to ensuring the long-term qualitative superiority of U.S. weapon systems.

The specific criteria for choosing critical technologies consider the potential impact of technological advancement on: (1) weapons system performance (improving existing systems and new capabilities); (2) current and future improvements in the quality of weapons systems (readiness/availability and affordability); and (3) the overall pervasiveness of a technology (in weapons systems or the defense industrial base). The 1990 Critical Technology Plan contains 20 technologies which are described in Table A-1.

An essential element in ONT's approach to the management of technologies is the recognition that achievement of mission-oriented technology objectives normally requires the orchestrated exploration, development, and maturation of a diverse collection of individual technologies. The key to success in the military high-technology arena is to couple the foundational technologies highlighted in the DOD Critical Technologies Plan with Service-managed core technology programs supporting specific mission areas and needs. Accordingly, the DON 6.2 program will continue to be developed under a management philosophy that stresses focusing on achieving a mission capability vice focusing on discrete technologies. This management scheme is depicted in Figure A-1.

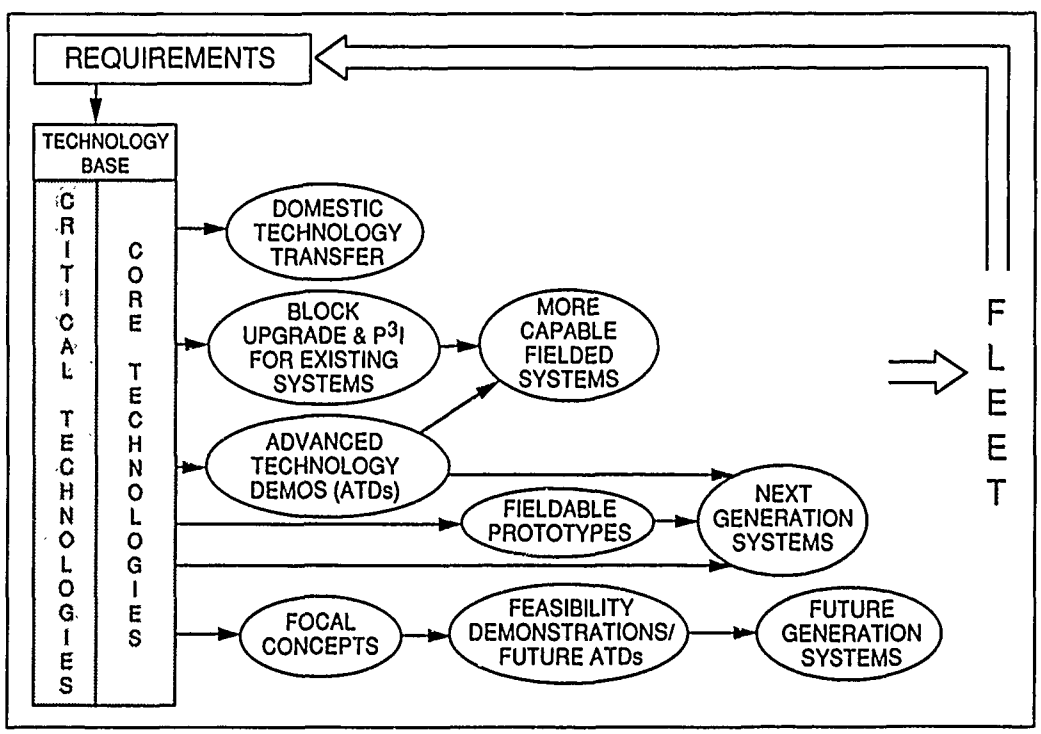


Figure A-1. DON MANAGEMENT SCHEME.

# Table A-1. DESCRIPTIONS OF 1990 DEFENSE CRITICAL TECHNOLOGIES

| | |
|---|---|
| 1. Semiconductor Materials and Microelectronic Circuits | The production and development of ultra-small integrated electronic devices for high-speed computers, sensitive receivers, automatic control, etc. |
| 2. Software Producibility | The generation of affordable and reliable software in a timely fashion. |
| 3. Parallel Computer Architectures | Ultra-high-speed computing by simultaneous use of all processing capabilities in the next generation of computers. |
| 4. Machine Intelligence and Robotics | Incorporation of human "intelligence" and actions into mechanical devices. |
| 5. Simulation and Modeling | Testing of concepts and designs without building physical replicas. |
| 6. Photonics | Ultra-low-loss fibers and optical components such as switches, couplers, and multiplexers for communications, navigation, etc. |
| 7. Sensitive Radars | Radar sensors capable of detecting low-observable targets, and/or capable of non-cooperative target classification, recognition, and/or identification. |
| 8. Passive Sensors | Sensors not needing to emit signals (hence passive) to detect targets, monitor the environment, or determine the status or condition of equipment. |
| 9. Signal Processing | Combination of computer architecture, algorithms, and signal processing for near real-time automation of detection, classification, and tracking of targets. |
| 10. Signature Control | The ability to control the target signature (radar, optical, acoustic, or other) and thereby enhance the survivability of vehicles and weapon systems. |
| 11. Weapon System Environment | The detailed understanding of the environment (both data and models) and its influence on weapon system design and performance. |
| 12. Data Fusion | The machine integration and/or interpretation of data and its presentation in convenient form to the human operator. |
| 13. Computational Fluid Dynamics | The modeling of complex fluid flow to make dependable predictions by computing, thus saving time and money previously required for expensive facilities and experiments. |
| 14. Air-Breathing Propulsion | Light-weight, fuel-efficient engines using atmospheric oxygen to support combustion. |
| 15. Pulsed Power | The generation of power in the field with relatively light-weight, low volume devices. |
| 16. Hypervelocity Projectiles | The generation and use of hypervelocity projectiles to (1) penetrate hardened targets, and (2) increase the weapon's effective range. |
| 17. High-Energy-Density Materials | Azides and other sensitive, high energy density compounds which offer the possibility of achieving energy releases of 10X to 200X of current explosive materials |
| 18. Composite Materials | Materials possessing high strength, low weight, and/or able to withstand high temperatures for aerospace and other applications. |
| 19. Superconductivity | The fabrication and exploitation of superconducting materials. |
| 20. Biotechnology Materials and Processes | The systematic application of biology for an end use in military engineering or medicine. |

ONT investments support and advance the development of the DOD Critical Technologies for multiple uses in military and industrial applications. Accordingly, approximately 40% of the DON 6.2 program resources are invested toward this goal. The relationship between the specific DOD Critical Technologies and the DON 6.2 Program Elements under which they are funded is displayed in Table A-2.

## Table A-2. DOD CRITICAL TECHNOLOGIES IN DON 6.2 PROGRAM

| DOD CRITICAL TECHNOLOGY | DON 6.2 PROGRAM ELEMENTS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | AAW/ ASUW | EW | ASW | MINE/ SPW | C3 | MSN SUPT | O&A SUPT | MARINE CORPS | A/C | SHIP | SUB | SYS SUPT |
| 1. SEMICONDUCTOR MATERIALS AND MICROELECTRONIC CIRCUITS | ● | ● | | | | | | | | | | ● |
| 2. SOFTWARE PRODUCIBILITY | | | | | | | | | ● | | | ● |
| 3. PARALLEL COMPUTER ARCHITECTURES | ● | ● | ● | | | | | | ● | | | ● |
| 4. MACHINE INTELLIGENCE/ROBOTICS | | | ● | ● | | | | | ● | ● | | ● |
| 5. SIMULATION AND MODELING | ● | ● | ● | | | ● | | ● | ● | ● | | |
| 6. PHOTONICS | ● | | ● | | | | | | ● | ● | | ● |
| 7. SENSITIVE RADARS | ● | | | | | | | | | | | ● |
| 8. PASSIVE SENSORS | ● | ● | ● | ● | | | ● | ● | ● | ● | | ● |
| 9. SIGNAL PROCESSING | ● | ● | ● | ● | | | ● | ● | ● | | | ● |
| 10. SIGNATURE CONTROL | ● | ● | ● | | | | | ● | ● | ● | ● | |
| 11. WEAPON SYSTEM ENVIRONMENT | | | ● | ● | | | ● | | | | | |
| 12. DATA FUSION | ● | ● | ● | | ● | | | ● | ● | | | |
| 13. COMPUTATIONAL FLUID DYNAMICS | ● | | ● | | | | | | ● | ● | ● | |
| 14. AIR-BREATHING PROPULSION | ● | | | | | | | | ● | | | |
| 15. PULSED POWER | | | | | | | | | | ● | | |
| 16. HYPERVELOCITY PROJECTILES | | | | | | | | | | | | |
| 17. HIGH-ENERGY-DENSITY MATERIALS | ● | | ● | | | | | ● | | | | |
| 18. COMPOSITE MATERIALS | ● | | | | | | | ● | ● | ● | ● | ● |
| 19. SUPERCONDUCTIVITY | | | ● | ● | | | | | | ● | | ● |
| 20. BIOTECHNOLOGY MATERIALS/PROCESSES | | | | | | ● | | ● | | | | ● |

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| | 62121N: | SHIP TECHNOLOGY |
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| | 62315N: | MINE & SPECIAL WARFARE TECHNOLOGY |
| | 62323N: | SUBMARINE TECHNOLOGY |
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## THE CHALLENGE ... FOR DON 6.2

IDENTIFY THE OPPORTUNITIES,
FOCUS THE RESOURCES,
MATURE THE TECHNOLOGIES ...
THAT WILL TAKE THE NAVY AND MARINE CORPS INTO THE 21ST CENTURY ...

*AND DO THIS IN AN EVER MORE CONSTRAINED FISCAL ENVIRONMENT*

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